LOW-LEVEL WIDE BAND MICRO-WAVE POWER MEASUREMENTS

BY

GILBERT BARTHOLOMEW BLISS

B.S., University of Illinois, 1933
M.S., University of Illinois, 1939

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ELECTRICAL ENGINEERING
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1949

URBANA, ILLINOIS
1949

LOW-LEVEL WIDE BAND MICRO-WAVE POWER MEASUREMENTS

BY

GILBERT BARTHOLOMEW BLISS

B.S., University of Illinois, 1933
M.S., University of Illinois, 1939

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ELECTRICAL ENGINEERING
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1949

URBANA, ILLINOIS

1949

ACKNOWLEDGMENT

I wish to express my gratitude to my teachers in Electrical Engineering. Especially do I wish to mention Professor Joseph Tykocinski Tykociner under whose tutelage this dissertation was written and to whom I owe thanks for directing my approach to the problems I have discussed.

I wish to express my thanks to Dr. Lloyd Thomas DeVore whose kind words more than once gave me new inspiration in overcoming the discouragements that come to a student.

And last but not least I owe a debt to my wife for her faith in me during the preparation of this thesis.

Gilbert Bartholomew Bliss

LOW-LEVEL WIDE BAND MICRO-WAVE POWER MEASUREMENTS

The main outcome of the investigation is a microwave power measuring device which combines an efficient power absorber and a resistance thermometer.

This device consists of a system of nickel wire coils wound on polystyrene cores of a conical shape and introduced in a section of a cavity or in a coaxial transmission line. When micro-waves are absorbed by the coils their temperature rises and their resistance correspondingly increases. This resistance increase is utilized in various ways to indicate the power absorbed directly or by methods of calibration.

Since the circuit elements of the coils are not selective they represent an absorber for a broad frequency band. Power measurements were made with this device when inserted in waveguides and also in connection with coaxial lines.

Data obtained with the absorber inserted in a cavity termination of a waveguide system have shown voltage standing wave ratios of less than 1.4 to 1 in the range of frequencies of 7,500 to 10,300 megacycles. Similar results in guides were obtained for frequencies available in the 10 cm band. However, lack of guide equipment made it impossible to cover a continuous band of 10 to 3 cm.

The best results were obtained with a conical termination having a summit angle of 4°. Standing wave ratios as small as 1.17 to 1 and lower were thus obtained over a band of frequencies of 8490 to 9860 megacycles.

When similar absorbers were used as terminations in a coaxial transmission line, the standing wave ratios obtained were not sufficiently small to give satisfactory results. Experiments made with nickel wires wound lengthwise within a section of a coaxial line indicates the possibility of improving the absorber so as to make it useful for a coaxial line.

Compared with known methods which utilize bolometer and thermistor units, the investigated method shows definite advantages in regard to broadbandedness.

The known methods are frequency sensitive to an extent that tuned frequency bands of not more than 10% can be obtained. On the other hand the new method covers a wide band of 50% without the necessity of tuning.

The sensitivity of the measuring device meets also the requirements originally set up. It is capable of measuring powers less than 0.5 watts. The actual power level was reduced to the milliwatt range. The only limitation for power levels below one milliwatt was found in the effect of ambient room temperature variations which masked the readings and therefore reduced the accuracy of measurements.

VITA

Gilbert Bartholomew Bliss was born December 23, 1909 in Chicago, Illinois. He attended grammer school in Maywood, Illinois and went on to later attend Proviso Township High School also in Maywood. He was graduated in 1928 and one year later began college work at Crane Junior College in Chicago and transfered after one year to the University of Illinois in Urbana, Illinois. He was graduated with the B. S. Degree in 1933 from the curriculum of Engineering Physics.

He worked in the field of radio and electronics as a development engineer, repair analyst and many associated positions for General Household Utilities Corp. of Marion, Indiana and Stewart Warner Co., Radio Division, Chicago until his return to the University of Illinois in 1937. He was awarded the M. S. Degree in Electrical Engineering in 1939. He left the Graduate School in June 1940 after completing preliminary work for the Doctorate to take charge of the research program of the Diamond Chain and Mfg., Co. of Indianapolis, Indiana. He was called into active duty in February 1942 and became a radar officer. After release from the Air Corps in March 1946 he recommenced his work for the degree of Doctor of Philosophy in Electrical Engineering.

Digitized by the Internet Archive
in 2026

https://archive.org/details/IA41549807_0107